

HAWAIIAN BOTANICAL HISTORY

Adapted from the course: Botany 130:
Plants in the Hawaiian Environment,
Hybrid course, TV and live lab



Koa flowers

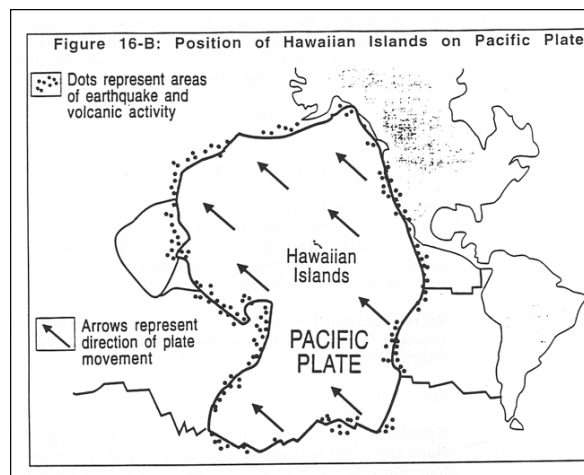
Why should we learn about native plants?

- Most endangered flora in the world
- Provides environmental benefits
- Part of Hawaiian culture
- Scientific value
- 90% unique
- Rapidly disappearing

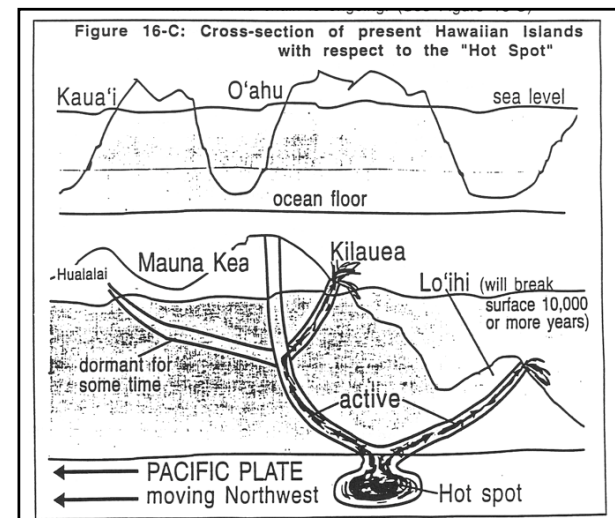


Ma'o hau hele, *Hibiscus brackenridgei*
ENDANGERED, State Flower

Hawaiian Islands on the Pacific Plate

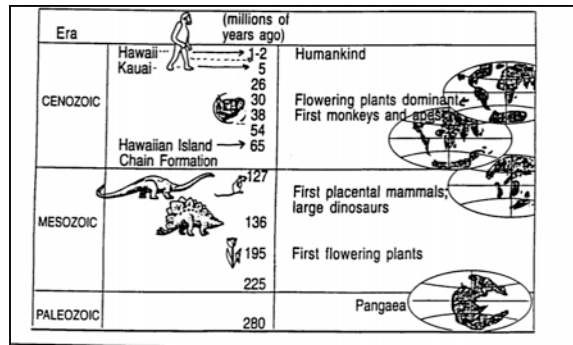


Site of “Hot Spot” Activity



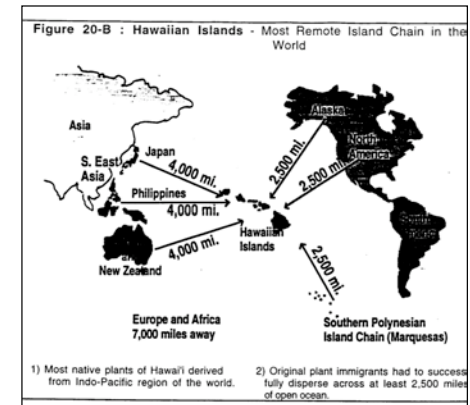
The Hawaiian Island Chain arose from the floor of the Pacific Ocean **after** the world's great continents were essentially **in the position they are found today**, and **all the recent plant and animal life** forms were also present on the earth.

This is in very recent geologic time for the origin of the Hawaiian Islands!



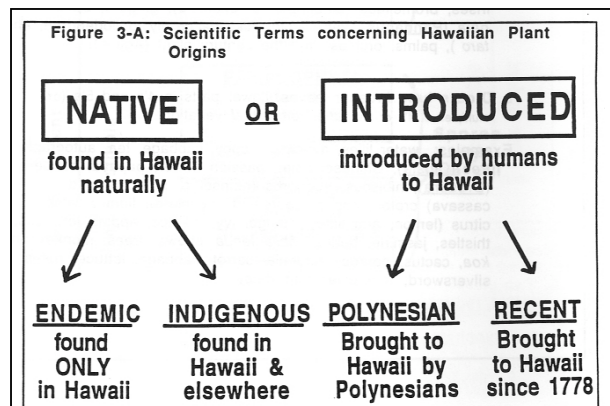
THE HAWAIIAN ISLANDS are the **most remote island chain in the world**

They are about 2,500 miles from the closest continental area, the Marquesas . Asia, southeast Asia, and Australia/New Zealand are 4,000 miles away. Original plant colonists, or immigrants, had to successfully disperse across at least 2,500 miles of open ocean!



NATIVE: Occurring naturally. Developed or migrated to the site without human help or intervention.

INTRODUCED: Brought to site intentionally or accidentally with human help or activity .



Native Plants: Endemic or Indigenous

INDIGENOUS : found naturally at others sites, not restricted.



Pohuehue, Native Beach Morning Glory

ENDEMIC: Found naturally only at the site and not elsewhere in the world.



Haleakala Sandalwood

Polynesian Introductions

POLYNESIAN INTRODUCTIONS:

Brought by original Polynesian voyagers to the islands.
Many have been here 1,000 or more years.
Botanists agree to 26 plus species.

Scientific Names

Aleurites moluccana *Alocasia macrorrhiza*
Artocarpus altilis *Broussonetia papyrifera* *Calophyllum inophyllum*
Cocos nucifera *Colocasia esculenta* *Cordia subcordata* *Cordyline fruticosa*
Curcuma longa *Dioscorea alata* *Hibiscus tiliaceus* *Ipomoea batatas* *Lagenaria siceraria*
Morinda citrifolia *Musa acuminata* hybrids *Piper methysticum* *Saccharum officinarum*
Schizostachyum glaucofolium *Syzygium malaccense* *Tacca leontopetaloides*
Tephrosia purpurea *Thespesia populnea* *Zingiber zerumbet*

Hawaiian /Common Names kukui , candlenut 'ape 'ulu , breadfruit wauke , paper mulberry kamani niu, coconut kalo ,taro kou ki or ti 'ōlena , turmeric uhi ,yam hau 'uala, sweet potato ipu , gourd noni mai'a , banana 'awa, , kava 'kō ,sugar 'ohe Hawaiian bamboo 'ohi'a 'ai , mountain apple pia , arrowroot 'auhuhu , fish poison plant, milo, 'awapuhi or shampoo ginger



Ape



Ohe



Pia

Hau
Flowers



Kukui



Awa
Stem



Kou flowers



Shampoo ginger

Recent Introductions

Many of these plants are called *exotics* , especially when referring to introduced cultivated plants like orchids, anthuriums, gingers, and heliconias.

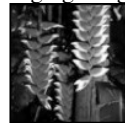
Anthurium



Yellow Ginger



Hanging Ginger



Orchids

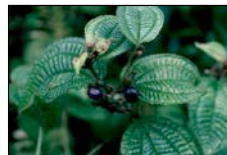


Also this group includes plants called **aliens** or **weeds**, which often have a negative impact on the environment, like haole koa ,scarlet-fruited or ivy gourd (*Coccinia grandis*)

Banana Poka



Scarlet-
Fruited
Gourd



Koster's
Curse

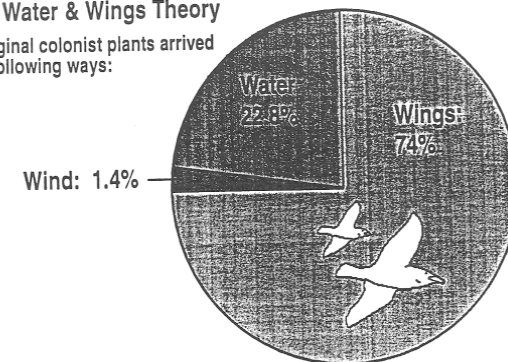


Wind, Water, and Wings

Figure 22-A: Calquist's Theory of Plant Dispersal to the Hawaiian Islands

Wind, Water & Wings Theory

The original colonist plants arrived in the following ways:



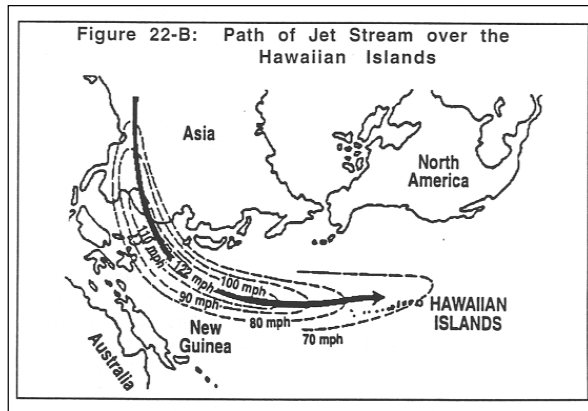
Wind Dispersal 1.4 %



Kupukupu Fern

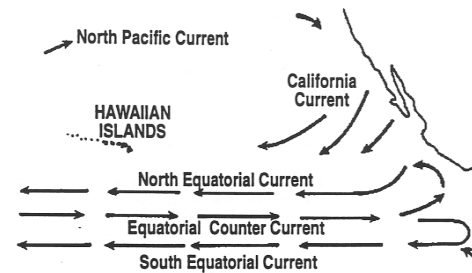


'Ohi'a
lehua

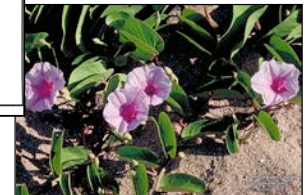


Dispersal by Water 23%

Figure 22-C: Hawaiian Islands are not in the Path of Major Currents



Akulikuli



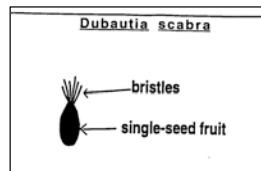
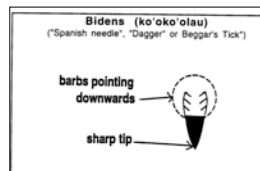
Pohuehue, beach
Morning glory



Naupaka

Wing - Bird - Dispersal 75%

Externally : 13%. Embedded in mud on feet or other parts.
10.3%. Attached by viscid or sticky substances.
12.8%. Attached by mechanical devices.



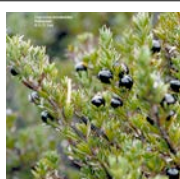
Internally : 39%. Carried in digestive tract of birds.



Hunakai, Sanderling



Vaccinium
Ohelo berry



Coprosma



Astelia
Pa'inui

Change of Characteristics of Colonist to Native Plants

They arrived, survived and thrived over several million years

COLONIZER CHARACTERISTICS

Weedy Aggressive
Seeds, Fruits & propagules small
Annual, rapidly establishing itself
Many armed with prickles thorns or chemicals such as poisons or strong, smelly oils.
Bisexual Flowers (Having functional stamens and ovary in one flower)
Easily dispersed by wind, water, or wing.
Coastal-adapted, originally from coastal areas

COMMON NATIVE TRAITS

"Fragile", easily displaced by introduced plants.
Large fruited/seeded
Perennial, woody, semi-woody,
generally slow growing
Thorn less, lacking chemical or physical defenses
Unisexual flowers with only male or female parts functional
Dispersal characteristics lost
Dryland plant forms evolved into wet forest forms

Example of Adaptive Radiation: the Silversword Alliance



Wilkesia



Dubautia



Argyroxiphium

The Silversword alliance is a group of closely related species (28) belonging to 3 different genera: *Ilia* (Wilkesia), *Na'ena'e* (Dubautia) and *Ahinahina* or the Silverswords (Argyroxiphium).

Adaptive radiation is a pattern of evolutionary development in which many different forms or species develop from a single founder organism. Colonist for these plants eventually adapted to many different environments that are found in Hawaii.

Major Vegetation zones of Hawaii

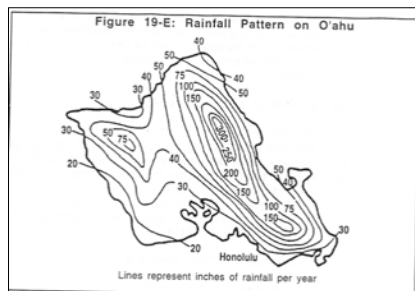
Strand, coastal, dryland forest and shrub, mixed mesic forest, rain forest, bogs, subalpine shrubland and desert, cliffs, lava flows with kipuka and exotic

Major determining factors are rainfall, temperature, elevation.



Kipuka, area of plants surrounded by lava

RAINFALL PATTERN ON O'AHU



Rainfall patterns closely matches vegetation zones

For instance, the broad area on the Leeward side of low rainfall, 20- 40" matches the dryland tree and shrub zone,

The tight lines along the mountain ranges are primarily in rain forest zones.

Dryland Tree and Shrub Area of Leeward CC



Dryland in Hawaii



Native tree: Wiliwili
Above, flower to left

Present Condition of Dryland Tree and Shrub Zone

Presently, dryland shrub and forest land is dominated by introduced grasses, which burn in hot fires that native plants cannot withstand. Also present is invasives such as lantana (*Lantana camara*), haole koa, mesquite, and prickly pear cactus (*Opuntia*).



Koa
Haole



Panini,
Prickly
Pear
Cactus

Occurs at 200-300 to 900 meters (600 to 2,700 feet). Little rain in summer, winter rains main source of water.

Mesic Forest Zone

Occurs at 740 to 1,250 meters (2220-3000 ft.), with rainfall about 50 to 100 inches per year

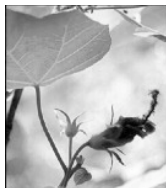


Characterized by having mostly trees and shrubs with an open canopy

Dominate Trees of Mesic Forest: Koa, 'Oh'ia and Sandalwood



Fragrant Ala he'e



Rare
Endemic genus
Hibiscadelphus



Ancient Koa, Strip road up to Mauna Loa

Historical Periods in terms of Human Impact

The historic periods can be divided into **three** : 1- Effects of Early Polynesians, 2- Early Post-Contact and 3- Changes Since 1850 (Recent).

EFFECT OF POLYNESIANS:

Agriculture probably had the greatest impact on native plants

Hawaiian irrigation systems were the largest and most sophisticated in Polynesia.

The Kona field system, one of the best, may have once supported one-half the population on 1% of the land. It had four zones, each with a different crop & microclimate

Also fire to clear land, erosion and de-forestation

EARLY POSTCONTACT PERIOD: Whaling ships, Sandalwood trade and importation of large herbivores had the greatest impact.

CHANGES SINCE 1848: The Great MAHELE, plantations, modern farming and urbanization.

PRESENT DAY STATE OF HAWAIIAN NATIVE PLANTS



Once forest,
Now pasture

Of the 1,100 species and subspecies in the Hawaiian flora, 270 are listed by the Federal Government as endangered. This is only the tip of the iceberg. Most of the islands are de-forested.

Agencies most involved in plant conservation in Hawaii

NATIONAL: U.S. National Parks has two parks in Hawaii - Volcanoes National Park on the Big Island and Haleakala on Maui. U.S. Fish and Wildlife Agency.

STATE: The Department of Land and Natural Resources has several programs to protect the endangered plants such as NARS (the Natural Area Reserves System) - large areas maintained under special protection. There are three on O'ahu - Mount Ka'ala, Ka'ena Point and Paole

Private Agencies: Two important national private, non-profit conservation agencies The Nature Conservancy which, in the last 15 years, has made monumental gains in consolidating private and public lands into protected regions; and The Center for Plant Conservation which now actively coordinates many programs of plant conservation on the islands.